PB-225 034

QUALITY OF LIFE INDICATORS

A REVIEW OF STATE-OF-THE-ART AND GUIDELINES DERIVED TO ASSIST IN DEVELOPING ENVIRONMENTAL INDICATORS

WASHINGTON ENVIRONMENTAL RESEARCH CENTER

DECEMBER 1972

Distributed By:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE

320003

PB 225 034/8

QUALITY OF LIFE INDICATORS

A Review of State-of-the-Art and Guidelines Derived to Assist in Developing Environmental Indicators

Environmental Studies Division
Office of Research and Monitoring
Environmental Protection Agency
December, 1972

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

BIBLIOGRAPHIC DATA SHEET	1. Report No.	2.	3. Recipient's Accession No PB-225 034
4. Title and Subtitle Quality of Life Indicators - A Review of State-of-the-Art and Guidelines Derived to Assist in Developing Environmental Indicators			5. Report Date December, 1972 6.
7. Author(s) Martin W. Brossman & Environmental Studies Division Staff			8. Performing Organization Rept. No. 62062
9. Performing Organization Name and Address Environmental Studies Division, Washington Environmental Research Center Office of Research & Development Environmental Protection Agency, Washington, D.C.			10. Project/Task/Work Unit No. 11. Contract/Grant No. N/A
12. Sponsoring Organization Name and Address N/A			13. Type of Report & Period Covered In-House 14.

15. Supplementary Notes

16. Abstracts

This report provides a review and assessment of the state-of-the-art of Quality of Life Indicators. Economic Indicators, Social Indicators, Environmental Indicators, and an all encompassing Quality of Life Indicator are discussed. The report traces the history of each catagory of indicator development, discusses the difficulties found and suggests guidelines for future indicator development.

17. Key Words and Document Analysis. 17a. Descriptors

Quality of Life Indicators
Indicators
Environment
Social Studies

17b. Identifiers/Open-Ended Terms

Quality of Life

17c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 93
	20. Security Class (This Page UNCLASSIFIED	22. Price $3.75

FORM NTIS-35 (REV. 3-72) THIS FORM MAY BE REPRODUCED USCOMM-DC 14952-P72

FOREWORD

This report summarizes an initial effort of the Environmental Studies Division, Office of Research and Monitoring of the Environmental Protection Agency in reviewing and assessing the state-of-the-art of Quality of Life indicators. The primary intent of this effort is to provide the staff with guidance in developing environmental indicators.

In the course of undertaking this effort a large volume of material has been reviewed, discussions conducted, and concepts assimilated and evaluated. The final result represents an amalgum and synthesis of related published work, concepts generated through discussion and in-house research. While every effort has been made to credit a prime known source, ommissions are inevitable in such a process.

The purpose of this report is to document the findings of the current work and to improve the dialogue among the various technical disciplines and decision makers whose talents are required to progress beyond this initial effort. A summary of the report was made available to the participants of the EPA Symposium on the "Quality of Life" Concept held at Airlie House, Virginia in August, 1972. The "Anthology of Selected Readings" prepared for this symposium provides additional material on Quality of Life Indicators.

TABLE OF CONTENTS

			Page
FOREWORD			i
CHAPTER	I	INTRODUCTION AND OVERVIEW	1
CHAPTER	II	ECONOMIC INDICATORS	16
CHAPTER	III	SOCIAL INDICATORS	32
CHAPTER	IV	ENVIRONMENTAL INDICATORS	42
CHAPTER	V	QUALITY OF LIFE INDICATORS--AN ALL ENCOMPASSING EFFORT	56
APPENDIX	A	MEASURING THE QUALITY OF LIFE AND ALLOCATING RESOURCES FOR ITS IMPROVEMENT	67
APPENDIX	B	BIBLIOGRAPHY OF RELATED WORK ON INDICATORS	77

CHAPTER I

INTRODUCTION AND OVERVIEW

A. Introduction

Indicators are, in principle at least, a key device for establishing where we are, how we are progressing, and guidelines for achievement of goals. Economic indicators--the Gross National Product (GNP), Composites of Leading Economic Indicators--are well known, if not always thoroughly understood, by the general public. Crime rates, unemployment rates, and consumer price indices are also widely and systematically reported. The developing and reporting of indicators is becoming so commonplace that one might assume we are dealing with a precise and well established technique, unambiguous in its application to a broad base of our national life.

A historical review of the evolution of indicators, however, indicates both their great utility and the considerable problems implicit in their development and use. Even well accepted economic indicators often involve complex compilations and adjustments which create wide disparities in interpretation by economists, politicians, and the general public. Growing applications of indicators from the economic area to social and environmental areas have accentuated the problems of development and use. In progressing to an even more encompassing area, Quality of Life, indicator definitions and concepts become increasingly more imprecise and difficult.

The following sections of this chapter describe the need for, and properties of, effective indicators, their historical evolution, and guidelines for indicator development and use. The remaining chapters discuss specific developments in economic, social, environmental and quality of life indicators. The report is designed to provide an overview of the field through selected examples of indicator evolution and development. A bibliography included in the Appendix provides a more extensive source of related work.

B. Problem and Need

The Gross National Product (GNP) has been generally accepted as a useful index or indicator of the "economic health" of the nation--it has served as a means of establishing goals, and as a "flag" to measure goal achievement. The credibility of the GNP has been questioned even as a gross economic indicator--but its strength lies in its overall acceptance as a useful tool--when properly applied.

Within recent years growing attention to the social and "environmental health" of the nation has led to the examination of the other indicators which will more adequately reflect the overall health and progress of the nation and its people. One desirable use of such indicators is to facilitate trade-offs between social, economic, and environmental goals. The establishment of such indicators

could provide an impetus for improved cost-benefit analysis at the national level. Another utility of such indicators involves the potential to combine them into a single indicator of the "Quality of Life".

Accepting the utility of a Quality of Life indicator and its associated economic, social and environmental components, the problems in development are formidable. What is an adequate set of indicators? How can we bring together in a unified effort a diversity of interests, backgrounds, and expertise--orders of magnitude greater than those involved in creating as useable a construct as the GNP? Can a focal point be created for such an effort to achieve an orderly and timely development?

The Environmental Protection Agency has an interest in such a potential development. Most of the standards related to the environment interact directly with our economic and social life. For example, pollution controls required to meet environmental standards often involve huge capital investment which can--at least in the short term--slow down our economic growth. A plant shutdown necessitated by noncompliance can directly impact on the economic and social structure of a community. The environmental problem is further complicated by its long term impacts. In many cases, we are faced with rectifying

damage requiring a long recovery cycle or evaluating impacts on biological processes which are not thoroughly understood. We are also faced with trade-offs which may involve inverse short-term and long-term effects.

Clearly, the Environmental Protection Agency, as well as other agencies of the national government, is faced with acute trade-off decisions which could be facilitated by the establishment of acceptable indicator systems. Accordingly, the Environmental Studies Division of EPA has undertaken an initial effort to assess the state of development of indicators related to the Quality of Life.

C. The Challenge of Developing a Quality of Life Indicator

Significant strides have been made, in technology and economic theory and practice, by modern society. Equal efforts and advances have not been made in assessing personal needs and assuring each individual an opportunity to achieve his full potential.

Such an effort would involve defining and gathering data of immense proportions, but could provide an effective guide for action. This information and its translation into a Quality of Life indicator could contribute to:

- Improved descriptive reporting
- The analysis of change
- The prediction of future events and needed actions for improvement of life quality.

These three tasks, of course, are interdependent. Adequate descriptive reporting is essential for the development of improved investigations of change, and correspondingly increased understanding of past changes is required for the better prediction of future events.

For the purposes of discussion, we will assume that an indicator reflecting the Quality of Life can be sub-structured into Economic, Social and Environmental indicators. We shall further propose some working definitions of indicators.

D. Indicators and their Requirements

Probably an acceptable synonym for "indicator" is "reflector". An indicator may, for our own purposes, be defined to be a statistic of direct interest which facilitates concise, comprehensive and balanced judgments about the condition of the major aspects of a society in relationship to its goals. Thus an indicator, in its most general form, may be defined as $I = \int \frac{\text{status}}{\text{desired level.}}$ (Specific examples of indicators are discussed in later chapters under the particular indicator topic area).

Opinion differs as to whether indicators must be normative. Indicators should, however, have direction, one pole being regarded as "good" and the other as "bad". The very process of developing indicators is value-laden, for what is regarded as good in the minds of some may be considered bad in the view of others. A simple example is

unemployment rate, where $I = \frac{\text{no. of unemployed employables}}{\text{employables}}$.

A high unemployment rate in a region may be distressing to the region's population but encouraging to an industry seeking a large labor pool--one looks upon the situation as an indicator of economic privation while the other looks upon it as an economic opportunity.

The method of measurement is extremely critical in the development and/or selection of indicators. The reduction of information to a numerical format opens possibilities for gross errors in the interpretation. For example, in the interpretation of an index such as IQ, one cannot assume that given two scores, 50 and 100, that the second score represents twice as much intelligence as the first. In other words, the underlying phenomenon may not be consistent with strict numerical interpretation of the indicator. A similar measurement is the decibel scale used in measuring the loudness of sound in which a unit increase in the decibel level represents a doubling of the loudness of the sound. Consequently, one must know the nature of the scale used. Thus indicators should be chosen so that interpretive errors of the type outlined above are as small as possible. In addition, indicators--in particular social indicators--are highly sensitive to the target population from which the information is derived, as well as the background of the

investigators who are proposing and developing the indicators.

The development and use of indicators requires well-defined information systems. Broad functions for which one would expect such information system and its related indicators to be useful are the following:

1. Detection of the state of affairs.
2. Evaluation.
3. Diagnosis.
4. Guide to action.

This last function, the "guide to action", is what all indicators strive to develop. However, effective guidance is highly dependent on the other functional performances. For example, in many instances evaluation is not self-evident. The difficulties of evaluation do not rest solely on personal differences--in taste or values--but on empirical questions as to what will be the eventual consequence of the state of affairs that has been detected.

E. History of Indicators--An Overview

In the history of the Western civilization, progress is repeatedly associated with efforts to obtain new kinds of information. Tracings of indicators have been found as far back as Biblical days and are scattered throughout the Old and New Testaments. During the Middle Ages, the Latin phrase "ratio status" (the predecessor of the word "statistics") was used to refer to the factual study of politics and

government. With the Renaissance and the Enlightenment, the idea of number was freed from the classical Euclidean confines of spatial boundaries and directly perceived magnitudes. Descartes and Leibnitz opened up new worlds of points, functions, transformations, the infinitesimal calculus, and infinity. Civilization entered an era in which time was measured out by mechanical clocks, but in which the prime symbol was pure and limitless space. Western political leaders and intellectuals started the endless process of collecting information on the "states of nations".

Attention to statistics and indicators began in the formative years of the United States. In 1790 James Madison obtained congressional agreement to break down the "Free White Male" population into 16 years and over and 16 years and younger--a category not required for the Constitutional enumeration, but certainly valuable for a new nation ready to start about its business. Jefferson went still further. As President of the American Philosophical Society, he asked Congress for a further breakdown of population by age, by native-born/foreign-born, and by occupation. Jefferson was turned down, but his proposed breakdowns were included in a federal census twenty years later.

Throughout our nation's history we have given attention to statistics and indicators. However, our primary attention,

with economic growth as our earliest national priority, was devoted to the economic sector and associated population data.

The information explosion and the use of indicators in our recent history has been influenced by the following:

1. The increasing maturation of the social sciences during the first two-thirds of this century, with ever greater attention to quantitative methods.

2. The emergence of corporation executives with fact-based styles of management and broader social perspectives.

3. Continuing efforts to provide more rational bases for political decision making.

4. The entry into public policy positions of a broadening array of intellectuals, professionals, modern-style managers, technologists, and natural and social scientists.

5. The acceptance of the "new economics" by both conservatives and liberals, with increasing attention to social and environmental as well as economic objectives.

The previous discussion has provided a brief overview of the history of indicators--covered in detail in the chapters on economic, social, environmental and quality of life indicators.

An analysis and synthesis of the lessons learned and guidelines derived for all indicator development are summarized in the following section.

F. Overall Assessment of Indicator State-of-the-Art and Guidelines

Having reviewed the history and use of indicators we have undertaken the assessment of lessons learned and the development of guidelines for the future.

1. Common Criteria for Indicator Development

A review of indicator developments previously summarized, leads us to postulate a set of necessary conditions influencing development and use of indicators as policy and action devices.

a. Urgency of need or overwhelming curiosity to provide a means to measure, control and improve our status.

b. Establishment of a commonly accepted value system or systems.

c. Effective interaction between the policy makers needing the indicators or measures, the professional community and the population involved.

d. Adequate information or data to construct and maintain the indicators on an ongoing basis.

In summation, effective indicators must be well defined, quantitative measures based on an acceptable value system, consistent in their interpretation and fundamental in their structure and capable of forming the basis of policy decisions and actions.

2. Relation of a Total Indicator Construct to Its Elements

The order of development of indicators traditionally has involved establishment of useful sub-indices over a long period of time devoid of a total construct. The GNP, for example, was a late development in the history of economic indicators. The knowledge gained in developing and utilizing previous economic indicators undoubtedly influenced development of the GNP. However, the GNP was an independent development borrowing from but not necessarily including--in the same form--economic indicators developed before.

The traditional development pattern of sub-indices and their lack of compatibility with an overall indicator development suggests an area of major improvement. A total methodology structure appears needed. This structure could provide guidelines for development of useable sub-indices which would become effective "building blocks" for overall indicators.

3. Priorities in Development

The economic health of our nation has traditionally received first priority--accordingly, the priority of development for Economic Indicators.

Having overcome the basis problem of economic survival and growth, we began--in more recent years--to focus on the more humanistic elements of the Quality of Life--social

consciousness and social indicators. This historical development suggests the impact of need and urgency in establishing our priorities of development. Secondly, one impetus for social indicator development may be the reaction to the former almost total preoccupation with economic matters. Despite apparent economic health, we were experiencing social upheaval and malcontent. A lesson to be derived here may be the necessity of at least attempting to reflect potential interactions between indicators. (Through definition of these interactions we may anticipate surprises and more effectively guide development.) Current interest in Social Indicators, however, has not reached the point of achieving a systematic impact on policy. The difficulty in defining and developing acceptable value systems and measures is a key impediment here.

Development of Environmental Indicators has, of necessity, been directed to areas of immediate hazard and concern. However, it is also apparent that an overall indicator of the environment is a necessary and critical need to provide policy guidance and a comprehensive measure of progress.

4. Necessity of a Quality of Life Indicator

An appraisal of the interactions of economic, social and environmental factors and the attempts to devise meaningful indicators clearly demonstrates the necessity of a Quality of Life Indicator. Meaningful trade-offs between these

factors can best be achieved within a framework that recognizes both the individual impacts and their interrelationships.

A Quality of Life Indicator could be extremely useful at the regional level in the United States. A recent paper by Peter House, Director of the Environmental Studies Division of the Environmental Protection Agency, discussed potential applications at this level.[1]

> "As a single measure of regional success, a performance model should be capable of summing the indicators (which are weighted in that they are comparable) to a quality of life index. This index can be used to measure the life style of the region as it progresses through time. Further, if the same index were used in all regions of the country, people in general would be given a valuable tool to compare the quality of life to what it would be in other regions in America.
>
> More importantly, this regional index could be further disaggregated to measure quality of life in various sectors of the subregion. Since the quality of life index is made up of three

---

[1] House, Peter. "Performance Criteria for the Environment", presented to the Annual Meeting and Equipment Exposition of the Institute of Environmental Sciences, May 4, 1972.

categorical indicators (economic, social, and environmental), cross comparisons of the sub-indicators by areas in the region also can be used for relative performance criteria.

In a practical sense, the public bodies which compare the region can use such indices to allocate their budgets to increase the quality of life for their citizens. On the other hand, business firms might find the measures useful as a barometer of where to locate new plants. Lobbying and politics might tend to take on a slightly different complexion as facts (as they are provided by the indicators) replace rhetoric."

In summary, an effective QOL indicator would have utility for the general public as well as providing an effective tool for government and business.

5. Critical Need of Indicators for Policy Guidance

It is axiomatic that establishment of effective national, state and local policy is dependent on knowing where we are, where we want to be and how to achieve desired goals. Indicators are a key element in meeting these requirements.

Policy makers, however, must clearly recognize the necessity for trade-offs. National economic priorities may impede social gains and environment improvement--at least

in the short range. While the trade-offs may be difficult, the policy maker should be aware of the impacts. An adequate set of economic, social and environmental indicators--and ultimately a quality of life indicator--can assist in making the difficult choices.

CHAPTER II

ECONOMIC INDICATORS

A. Introduction

This chapter of our report summarizes the historical development of economic indicators, concepts and problems involved in their use and guidelines derived for development of indicators. Emphasis has been placed on those aspects of special value in obtaining a better grasp of concepts useful in overall indicator development.

B. History of Economic Indicators

Economic statistics have played a vital role in the formulation of public and private policy in the U.S. The national income accounts were begun in 1932 in response to the need for better information to deal with the Depression economy. The first focus was on estimates of contributions to national income provided by agriculture, mining, manufacturing, transportation and services, and of the distribution of this national income in the form of wages, rents, profits, dividends and so forth.

The national income estimates were overhauled in 1947 to make them into a comprehensive national accounting system. In 1951, the previous series were converted to constant dollar terms to eliminate the artificial movement in the estimates due to inflation and deflation. These "real" estimates of GNP were used as a measure of changing trends

in national productivity and standards of living. GNP was also divided into consumption, investment, and government purchases.

Economic statistics may deal with the measure of level and/or rate of change of quantitative and/or qualitative economic phenomena. Using the example of GNP, the level or quantity of GNP can be expressed as a measure in terms of dollars or in terms of dollars per capita. The rate of change of the level is usually expressed in percentage change during the course of a year.

The long term development of economic measures and economic indicators has led to an extensive series of economic statistics and accounts. Some examples of these statistics and accounts are described in the following sections. The extensive developments described however, tend to mask many shortcomings. A large information base has evolved to support the development of economic statistics, accounts and indicators. Many emerging areas of economic impact and concern are not reflected in this data base. Furthermore, interpretation of the meaning of many economic indicators is subject to a wide diversity of interpretation. Examples of these problems are discussed in the section of this chapter titled "Difficulties to be Overcome".

1. Current Economic Indicators and Their Constituents

Some of the properties of economic statistics will be illustrated through reference to the different statistics used to describe the dollar value of national production.

a. The Gross National Product

The Gross National Product (GNP) is a purely descriptive term. It represents the value at current market prices of all final goods and services produced by a nation's economy before deduction of depreciation charges and other allowances for business and institutional consumption of durable capital goods. The GNP per capita measures the gross national product in relative terms by using the per capita figure to compare an output number with a consumptive unit--once a desirable standard or threshold is established, this measure can be converted to an indicator. An example of conversion of a measure to an economic indicator is inequality of income distribution. The median personal income of the top ten percent of the income earning families divided by the median income of the bottom ten percent of the income earning families is a measure of the inequality of the income distribution. If a value greater than two is expected but a value less than ten is desired, an indicator would be derived from this measure by seeing how much below or above the value of ten it is.

b. Current Measurement Techniques

Most economic statistics are measured directly using business surveys (especially the periodic Census of Manufacturers and Census of Business), Internal Revenue Service tabulations, continual sampling, and other governmental records. Some indirect measurement is made in the form of imputations such as those for the rental value of owner-occupied housing. Other possible imputations for GNP, such as the value of housework performed by housewives, have been omitted from GNP estimates although some would argue that such "output" should be included as part of GNP.

This issue of whether to include the value of housework performed or not illustrates that even in a concept such as GNP, which we categorize here as a "measure", is the product of many statistical maneuvers, several of which might be considered normative and of unequal importance by different segments of the general public.

c. Examples of Current Economic Statistics

Some of the most commonly known and popularized current national economic statistics are:

GNP

Unemployment Rate

Balance of Payments

Personal Income

Investment

Dow Jones Index

Modified versions of these statistics are useful as regional and metropolitan descriptors. Perhaps the most significant developments in concepts of economic accounting of utility at the regional level are represented by the work of Isard and colleagues and reported in the MIT Press Regional Science Studies Series.[1] A recent book in the series provides a rationale for incorporating regional level considerations in national economic accounts.[2] The Bureau of Labor Statistics publishes a set of unemployment statistics for metropolitan areas. A balance of trade measure has been calculated for the states for which input/output tables have been constructed (e.g., Utah and California). Also, the Office of Business Economics publishes regular estimates of state and metropolitan personal income, as well as its national "Survey of Current Business".

d. Relationship of Economic Indicators and Economic Accounts

Edgar Dunn (1971), of Resources for the Future, points out the important distinction between simple indicators (e.g., rates of production, volume of sales, etc.) and accounts (integrated sets of information). Accounts "are designed to give empirical content to an image of the functional relation-

---

1 Isard, Walter (Ed.). Regional Science Studies Series, MIT Press, Cambridge, Mass.

2 Leven, Charles L., John B. Legler, and Perry Shapiro. An Analytical Framework for Regional Development Policy, MIT Press, Cambridge, Mass., 1970.

ships that define the total system itself (or some important set of total system relationships). They provide an information base for total system guidance and management.[1]

Integrated statistical information systems have been made increasingly attractive to cities with the availability of large-scale computers, improving governmental statistics and periodic census information. The Federally-sponsored USAC (Urban Information Systems Inter-Agency Committee) program has provided funds for several cities to develop systems of urban accounts.

Richard Stone (1970) suggests four characteristics needed to develop an integrated statistical system; i.e., accounts: 1) a common unit of measure; 2) a set of consistency criteria; 3) interrelationships; and 4) the capability to project.[2] Economic accounts meet these four criteria with 1) dollars; 2) income equals expenditures plus saving; 3) expenditures are a function of income; and 4) macro-economic forecasting models.

---

1 Dunn, Edgar S., Jr. "The National Economic Accounts: A Case Study of the Evolution Towards Integrated Statistical Information Systems", Resources for the Future, Washington, D.C., May, 1971.

2 Stone, Richard. "An Integrated System of Demographic Manpower and Social Statistics and Its Links with the Systems of National Economic Accounts", 16th Session, Statistical Commission, United Nations Economic and Social Council, E/CN, 3/390, May 28, 1970.

e. Examples of Economic Accounts

Two examples of economic accounts will illustrate the complexity of the economic accounting performed today.

(1) Conventional Economic Accounts

The conventional economic data at the national level are divided into the national income accounts, flow-of-funds data, and input/output data.

(a) National Income Accounts

The national income accounts cover five sectors of the economy:

(1) The Gross National Product (GNP) shows the purchases of final output and the distribution of income generated by the production of that output to the factors of production (income to workers, taxes, and profits).

(2) The personal income account shows the sources of income to persons (wages, social security benefits, dividends, etc.) and how that income is disposed of (consumption, personal taxes, and savings).

(3) The public sector account shows the revenue receipts from personal and corporate sources, intergovernmental aid, and contributions for social insurance. It also shows expenditures for defense and other goods and services, social security and other payments to persons, interest paid, and subsidies.

(4) The balance of payments account shows the foreign trade in terms of imports, exports, transfers to foreign persons and governments, and net foreign investments.

(5) The saving and investment account shows the excess of income over expenditures in each of the other accounts and shows the capital formation by private and public bodies.

(b) The flow-of-funds data show the sources and uses of funds by the different sectors of the economy. The national income accounts cover only current income and expenditure transactions and, thereby, exclude financial transactions that merely alter the assets and liabilities of the various sectors of the economy.

(c) Input/output data shows the purchase of inputs and the sale of outputs by industrial sectors of the economy. These data are not available on a regular basis because of the large cost to determine the annual figures. Several national input/output tables have been constructed and many regional input/output tables have been developed for various time periods. In almost all cases, the intended use of the table has dictated how the industrial sectors were aggregated (i.e., where 2-digit SIC or some mix of the Standard Industrial Classification scheme was employed).

(2) Resources

The physical resources used in the production process can be classified as renewable (agriculture, forestry and fishing) or non-renewable (mining) depending upon whether the stock of resources may be increased or not.

Even mineral resources which will be classified as non-renewable have the ability to grow (in a sense) through new discoveries and via the laboratory where new materials can be "created".

Data on the status of renewable and non-renewable resources show that there are more broad feet of timber in the U.S. now than in previous years (50% more in 1963 than in 1945), there are more proved U.S. oil reserves in 1970 than in 1960 (27% more), and slightly more natural gas reserves in 1969 than in 1960. (World-wide estimates, however, are not so optimistic. Several key minerals are forecasted to be depleted within the next 25 years.)

f. Relationship of Economic Indicators and Economic Measures

The description, measurement, and evaluation of the economy of a geographical area (nation, state, region, metropolitan area, or smaller areal unit) will be discussed here in a slightly unconventional manner, for economists, but in conformance with the indicator rationale previously discussed. The term "economic indicator" will be reserved for those measures of the economy that have been evaluated

in light of some set of goals or in terms of some value system. In other words, a statistic such as the rate of gross national product is considered to be a measure until a value or goal is assigned to the measure to establish it as an indicator of the attainment of a value or a goal. It is generally agreed that economic measures should indicate the absolute and relative level of a phenomena, its rate of change (most commonly over a year period), and its distribution (both spatially and among various population groups, if possible).

Economic measures and indicators have been developed to reflect the present and changing state of various economic quantities (the economic system, businesses, individuals, governments or other institutions) for use by various participants in the economic system (business, individuals, governments or other institutions).

The previous section has described the historical development of economic indicators, and the current sophisticated statistical accounting structures from which these indicators are developed. The following section will describe some of the problems in use and interpretation of economic indicators which need to be overcome.

C. Difficulties to be Overcome

The economic indicator area has generally been recognized as the most advanced level of indicator development. Despite this generally-held belief, the establishment of goals and

questions on the interpretation and meaning of economic indicators continually pose serious problems.

1. Difficulties in Establishment of Goals

The 1960 Report of the President's Commission on National Goals states the economic goals of the nation in no uncertain terms: "The economy should grow at the maximum rate consistent with primary dependence upon free enterprise and the avoidance of marked inflation." This maximum growth is desired for its supposed creation of jobs, to improve the U.S. standard of living, and to assure U.S. competitive strength.

Two additional statements by task force members encouraged that the U.S. economic growth rate: 1) be large enough to allow for growing public expenditures with "tax rates no greater and, hopefully, even lower than those now being levied", and 2) be "not less than 4 percent, and, if reasonably possible, 5 percent annually".

Other goals are related to the economic growth goal. For example, one of the reasons given for improving education is that it will help the growth of the economy. Even more direct is the justification for technological change: "Technological change should be promoted and encouraged as a powerful force for advancing our economy".

In the past, and probably at this time as well, the majority of people in the U.S. would favor a large positive value of this rate of growth of real GNP per capita (R). However, the growing number of Zero Population Growth advocates would most likely favor a zero or very small positive R.

Yet another group of individuals (possibly called the "Limits to Growth" advocates) might actually favor a negative R for most of the developed countries, particularly the U.S. This example of the varying attitudes toward the value of R is presented to illustrate the point that indicators will always be accompanied by a standard or goal that must be set by one or a group of human decision-makers. As another example, the Employment Act of 1946 aims for a low unemployment rate, but it has always been acknowledged that a zero rate of unemployment is unattainable and not desired (the goals set by the Council of Economic Advisors in the recent past ranges from 3 to 4 percent unemployment).

2. Problems in Interpretation of Economic Indicators

A cogent example of the problem of interpretation of indicators is illustrated by a recent article by Gardner Ackley.[1] This article also demonstrates how economists with opposing outlooks can interpret indicators in a significantly different fashion. An abstracted portion of the article will highlight some key points in the context in which they were made:

> On June 28, the U.S. Department of Commerce released its preliminary report of the "composite index of leading economic indicators" for May...

---

[1] Ackley, Gardner. "The 'Leading Indicators' Where do they Lead?", Dunns, August, 1972.

> Most people who read and talk about this index have no idea what it is, but only believe that its movements "tend to foreshadow future performance of the economy."...
>
> When the preliminary May index was released, adjusted data was available for 8 of the 12 series. Two of these had risen sharply in May--building permits and industrial material prices--while the other six had declined, most of them moderately. The net change for the eight series was a rise of 0.2 percent...
>
> But precisely what did this indicate about the course of the economy in, say, the second half of 1972? Are the economic activities that these series represent believed to "cause" what comes later for the economy generally? That was not the criterion for their selection. Rather, these particular series were chosen--from among the many hundred available series, each of high technical quality, for which current data are promptly available--essentially because, in the past, they tended most consistently to turn upward in advance of the low points of recessions, and downward in advance of the advent of recessions...
>
> The best one could say is that the index might permit recognition--a few months earlier than otherwise--that a turn had occurred...
>
> There is very little evidence that, once a turning point in business has occurred, the extent of movement of the index provides useful information about the future of business activity...
>
> So the leading index may not lead anywhere.

The foregoing case and its analysis--while an individualistic one--illustrates: the lack of public understanding of the

contents and meaning of some of our commonly accepted economic indicators; fundamental questions as to whether cause and effect relationships are well enough known--even for commonly acceptable indicators--that such indicators can lead to effective policy and action; the subjective choice of elements and data of which constitutes an indicator; and the need for guidelines in interpretation of the short and longer range significance of indicators.

3. Interactions of Economic, Social and Environmental Indicators

Determining a qualitative indicator of GNP involves value judgments as to the inclusion or deletion of components. For example, William Nordhaus makes a number of changes in GNP and comes up with what he calls the Measure of Economic Welfare (MEW).[1] The MEW is a measure of real consumption rather than of output. It nets out GNP factors that do not contribute directly to domestic welfare (depreciation, some business expenses,

---

1 Nordhaus, William and James Tobin. "Is Growth Obsolete?", Cowles Foundation Discussion Paper No. 319, Cowles Foundation for Research in Economics, Yale University, New Haven, Conn., 1971.

Nordhaus, William. "GNP and The Quality of Life", presented at AAAS Symposium "Can We Develop an Index for Quality of Life?", December 30, 1971.

certain expenditures for running local and federal governments, and others), and it nets our "disamenity" costs of growth such as the implied compensation to city dwellers for pollution, congestion, noise, and other discomforts. Dr. Fred Singer of the University of Virginia is currently building an economic model of the United States which nets out economic costs which do not contribute to the economic wealth of the nation.

Adjustments to the GNP may include many aspects of environmental impact. For example, it appears that a case of double counting currently exists--dollars that are spent to control air pollution are added to dollars that created the pollutants in the first place. This situation could be corrected by deducting from GNP the costs of eliminating all the pollutant residuals associated with manufacturing outputs (resulting from the production, shipping, and consumption processes). Thus, as expenditures are made to eliminate or deal with the pollutants, GNP would rise but the present appearance of "double counting" would be removed.

D. Guidelines for Indicator Development

The following are some general guidelines derived from our review of economic indicators:

1. It is important to look to the future when establishing a set of components that comprise an economic

index, as in all indicators. Most of what we measure today may have less importance given the likelihood of various future events, and conversely, some things that we fail to measure today may take on increased importance in the future.

2. Indicators are too frequently constructed on an historical basis without a clearly understood cause and effect relationship. Therefore, we are frequently unsure of the impact of policies designed to improve performance.

3. The selection of the data base from which indicators are constructed, even in the economic sphere, is generally subjective and often dominated by the availability of current data.

4. The significance of the absolute value of rise and fall of an indicator must be evaluated both in terms of its "rugged structure" and "sensitivity".

5. The interrelationship of economic, social and environmental factors should be reflected in economic indicators. Without a careful accounting of such factors the individual indicators will be misleading and can lead to ineffective policies.

CHAPTER III

SOCIAL INDICATORS

A. Introduction

The limitations of economic indicators in reflecting adequate measures of the Quality of Life led to a concentrated effort during the past decade to develop social indicators. This chapter traces some of the significant impetus and developments of such indicators, difficulties to be overcome, and derived guidelines for indicator development.

B. History of Social Indicators

The growing national concern for adequate inclusion of social impacts in our policies and actions is reflected by questions raised early in the 1960's by Raymond A. Bauer and others, "If we have highly organized economic indicators, why can't we set up a system of social indicators as well?". This was followed by efforts of the American Academy of Arts and Sciences, Bertram M. Gross, the Russell Sage Foundation and others until President Johnson formally assigned a transdepartmental mission to the Department of Health, Education, and Welfare. In his message to Congress on March 1, 1966, the President asked the Secretary of HEW "....to establish within his office the resources to develop the necessary social statistics

and indicators to supplement those prepared by the Bureau of Labor Statistics and the Council of Economic Advisors."[1]

At about the same time, another major thrust to the Social Indicator movement came from some thoughts of the report of the National Commission on Technology, Automation, and Economic Progress, "Technology and the American Economy", (1966). This report proposed a "system of social accounts" to "indicate the social benefits and social costs of investment and services and, thus, reflect the true costs of a product."[2]

In 1967, Senator Walter C. Mondale (Minn.) and a group of ten Senators called for legislative structure for annual social reporting by the President, with professional assistance and congressional participation. The major sections of their proposed "Full Opportunity and Social Accounting Act" (S 843) provided for:

(1) An Annual Social Report of the President to be transmitted by March 20 of each year.

(2) A Council of Social Advisors to assist in preparing the report and working on the underlying studies and data.

---

1 President Lyndon B. Johnson, Message to the Congress on Domestic Health and Education, March 1, 1966.

2 National Commission on Technology, Automation, and Economic Progress, Technology and the American Economy, 1966, p. 95.

(3) A Joint Committee on the Social Report (composed of eight Senators and eight Representatives) to review the Social Report and transmit its findings thereon to the Congress by June 1 of each year.

The Department of Health, Education and Welfare submitted its report, titled "Toward a Social Report", to the President in January, 1969. The document was meant to represent a preliminary step toward the evolution of a regular system of social reporting. In the cover letter of the report, the Secretary of HEW, Wilbur Cohen, strongly recommended "the continued allocation of staff resources in the Executive Branch to prepare a comprehensive social report to the Nation with emphasis on the development of social indicators which will measure social change and be useful in establishing social goals".[1] Some examples of the Social Indicators suggested in this report and hearings on the "Full Opportunity Act" are shown in Exhibit III-1.

The proposed Mondale Bill, which did not emerge from the Committee when it was introduced in 1967, was passed as S.5, The Full Opportunity and National Goals and Priorities Act on September 10, 1970 by the Senate.

---

[1] Letter from Wilbur J. Cohen, Secretary of HEW, to the President of the United States, January 11, 1969.

EXHIBIT III-1

Examples of Social Indicators*

1. Infant mortality (per 1,000 live births).
2. Maternal mortality (per 100,000 live births).
3. Family planning services for low-income women 15 to 44.
4. Deaths from accidents (per 100,000 population).
5. Number of persons in state mental hospitals.
6. Expectancy of healthy life.
7. 3-5-year olds in school or preschool.
8. Persons 25 and older who graduate from high school.
9. Persons 25 and older who graduate from college.
10. Persons in learning force.
11. Percent of major cities with public community colleges.
12. Number of 1st-year students in medical schools.
13. Handicapped persons rehabilitated.
14. Average weekly hours of work--manufacturing.
15. Labor force participation rate for women aged 35-64.
16. Average annual paid vacation--manufacturing.
17. Housing units with bathtub, or shower.
18. Percent of population illiterate.
19. Voters as a percentage of voting age population.
20. Private philanthropy as a percent of GNP.
21. Public and private expenditures for health, education, and welfare as a percent of GNP.
22. Percent of population in poverty.
23. Income of lowest 1/5 of population.
24. Persons who work during the year.
25. Life expectancy.

*Presented to Congress by Wilbur Cohen. Full Opportunity Act--Hearings before the Special Subcommittee on Evaluation and Planning of Social Programs of the Committee on Labor and Public Welfare, U.S. Senate, Ninety First Congress.

However, the bill was not acted on by the House. In January, 1971, Senator Mondale again reintroduced the bill in Congress, again as S.5.[1] This time it was co-sponsored by 22 Senators from both parties.

Meanwhile, during the middle and late 1960's social indicator work was being pursued by people like R.A. Bauer, A.D. Biderman, D.D. Duncan, B. Gross, M.V. Jones, M.J. Flax, E.B. Sheldon and others. More recently the Social and Rehabilitation Service of HEW, in particular its Division on Aging, has sponsored significant research in development and evaluation of Social Indicators. Fundamental work on social indicators has also been sponsored by the Bureau of Research, U.S. Office of Education.[2] A useful compilation of the chronological milestones of social indicator development is included in the report "Social Indicators".[3]

Perhaps the most significant attempt to develop social indicators at a policy making level is the current effort within the Office of Management and Budget (OMB).

---

1 Congressional Record, Proceedings and Debates

2 See, for example, "Toward Master Social Indicators" a report prepared in 1969 by Standard Research Institute for the U.S. Office of Education.

3 Schmalz, Anton B., et al. "Social Indicators" report for National Science Foundation by New World Systems, Inc., July, 1972.

Exhibit III-2 illustrates a partial listing of some of the initial categorizations of "Social Concerns" being developed within the Office of Management and Budget. Initial categorizations such as these are essential to the development of measures and subsequently indicators. OMB is scheduled to publish its first annual report on Social Indicators early in 1973.

The current social indicator movement is attempting to meet pressing needs; namely, first our need to know how and in what respects our life is getting better or worse; secondly, our need for comparisons to show how well we are doing in preserving or improving the quality of life in one community, state, or nation relative to another; thirdly, society's need for statistics to make benefit-cost checks on the output or performance of the professions and business to which citizens directly or indirectly entrust their dollars.[1]

C. Difficulties to be Overcome

In spite of the high-level recognition given to social reporting and indicators and the extensive efforts of experts in the field, it is still generally acknowledged that the current state of social reporting and indicators is underdeveloped.

---

[1] Gastil, Raymond D., "Social Indicators and Quality of Life", Public Administration Review, November/December, 1970, pp. 596-601.

EXHIBIT III-2

SOCIAL CONCERNS*

A. Health

1. Long Life
2. Physical and Mental Well-Being

B. Education

1. Basic Skills for Everyone
2. Opportunity for Advanced Learning

C. Employment

1. Employment Opportunities
2. Work Environment and Job Satisfaction

D. Income

1. Level of Personal Income
2. Income Distribution
3. Low Income Population

E. Housing and the Environment

1. Housing and Quality of Living Conditions
2. Neighborhood Quality
3. Environmental Quality

F. Leisure and Recreation

1. Leisure Time Available
2. Participation in Leisure-Time Activities

G. Public Safety and Legal Justice

1. Safety of Life and Property from Crime
2. Equitable Criminal Justice

H. Population

1. Population
2. Living Arrangements and Family Structures

*A partial listing of categorizations developed by U.S. Office of Management and Budget.

Confusion and difficulties surrounding social indicators include: lack of agreement on an acceptable definition and methods of construction for social indicators, uncertainty as to whether indicators should include qualitative measures as well as quantitative, disagreement on the concept that indicators must be "normative", lack of understanding and agreement on the use to which indicators can be put, the question of the validity of the indicators, and the enormity of the task of providing indicators, and improving the quality of social statistics and reliability of social science information.

D. Guidelines for Indicator Development

Despite the conceptual and practical difficulties in developing social indicators, the need for such indicators is recognized by social scientists, social commentators, political activists, and legislators alike. Furthermore, there is agreement that social indicators should have the following characteristics:

(1) Measure some aspect of life which is thought to be related to human well-being and satisfaction.[1]

---

[1] Flax, Michael J. "Future Prospects for the Development of Additional Social and Urban Indicators", Working Paper V, The Urban Institute, July 1, 1971.

(2) Provide time series that allow comparisons over an extended period and which permit one to grasp long-term trends as well as unusually sharp fluctuations in rates.[1]

(3) Utilize statistics that can be disaggregated by relevant attributes of either the persons or the conditions measured (such as skin color or year of construction) and by the contextual characteristics that surround the measure (such as region or city size).[2]

(4) Include widespread community participation in developing indicators to insure that the indicators reflect what the community wants. (As noted in a 1970 Consad report, the information on people's wants that these indicators reflect provides a deeper understanding of social conditions, so that better planning and implementation of public programs affecting these conditions can be achieved.)[3]

---

1 Sheldon, E. B. and H. E. Freeman. "Notes on Social Indicators: Promises and Potential", Policy Sciences I, 1970, pp. 97-111.

2 Ibid.

3 Consad Research Corporation. "The Design of a Central Social Environment Study", Final Report, June 1970, Prepared for New York Office of Program Planning and Coordination.

(5) Match the needs of the decision and policy maker with the data collected for development into indicators.

(6) Describe an output measure. (For example statistics on the number of doctors or policemen are not social indicators, whereas figures on health or crime rates could be.)[1]

In summary, it is clear that we must know what we are after and how the results will be used in order to develop menaingful indicators in any area.

---

[1] Department of HEW (1969) "Toward a Social Report", Government Printing Office, Washington, D.C.

CHAPTER IV

ENVIRONMENTAL INDICATORS

A. Introduction

In contrast to the more highly developed economic indicators and the past ten years interest in social indicators, environmental indicators are a very recent development area. A milestone in recognizing the need was the National Environmental Protection Act of 1969 which mandated that the Council on Environmental Quality (CEQ) prepare a set of indices to measure the state of the environment. CEQ's mandate has hastened the development of environmental indicators, particularly in areas of greatest urgency such as water and air quality. In addition, tentative indicators have been proposed to assess the overall quality of our environment.

B. Related Work

Work directed at developing environmental indicators for areas of immediate urgency is typified by such reports as: "Oak Ridge Air Quality Index", September 1971, by Thomas, Babcock, and Shults of the Oak Ridge National Laboratory; and "Environmental Indicators for Pesticides", by Strickland and Blue of Standford Research Institute.

Specific examples of indexes of water quality will illustrate the form and complexity of their definition and use.

The Mitre Air Quality Index (MAQI) is a combination of individual pollutant indexes each based upon one of the secondary

air quality standards. This index is computed as follows:

$$MAQI = \sqrt{I_c^2+I_s^2+I_p^2+I_n^2+I_o^2}$$

where

I_c is an index of pollution for carbon monoxide,

I_s is an index of pollution for sulfur dioxide,

I_p is an index of pollution for total suspended particulates,

I_n is an index of pollution for nitrogen dioxide, and

I_o is an index of pollution for photochemical oxidants.

The individual indexes are computed from similar relationships as the following example of the index for carbon monoxide.

$$I_c = \sqrt{\left(\frac{C_{c8}}{S_{c8}}\right)^2 + \delta\left(\frac{C_{c1}}{S_{c1}}\right)^2}$$

where

C_{c8} is the maximum observed 8-hour concentration of carbon monoxide,

S_{c8} is the 8-hour secondary standard value (i.e., 9 p.p.m. or 10,000 g./m^3) consistent with the unit of measure of C_{c8},

C_{c1} is the maximum observed 1-hour concentration of carbon monoxide,

S_{c1} is the 1-hour secondary standard value (i.e., 35 p.p.m. or 40,000 g/m^3) consistent with the unit of measure of C_{c1}, and

δ is 1 if $C_{c1} \geq S_{c1}$ and is 0 otherwise.

An alternate index for air quality the Oak Ridge Air Quality Index (ORAQI) is of the following form:

$$ORAQI = \left(39.02 \sum_{i=1}^{3} \left(\frac{\text{Concentration of pollutant i}}{\text{EPA standard for pollutant i}}\right)\right)^{0.967}$$

The MAQI and ORAQI indexes for water quality utilize different physical measurements and involve different combinational processes. Neither index is as yet an accepted national standard illustrating that even in such a seemingly fundamental area as air quality much remains to be done in establishment of an acceptable indicator.

Other indicator work directed at special ecological problems is typified by such reports as: "National Environmental Indices--Air Quality and Outdoor Recreation", April 1972, by Bisselle, Lubore, and Pikul of MITRE Corporation; "Development of a Continuing Program to Provide Indicators and Indices of Wildlife and the Natural Environment", April 1972, by Jenkins, Ecology Program, Smithsonian Institute; and "Land Use Indicators of Environmental Qual ", prepared by the staff of Earth Satellite Corporation. An example of a proposed total environmental index is the EQ (Environmental Quality) Index, published annually by the National Wildlife Federation. Its presentation is both pictoral and numerical. In addition to an overall environmental quality index with yearly trends, it presents air quality, mineral, water, living space, wildlife, timber and soil environmental quality indexes. While a diversity of opinion exists regarding the methods of computation, the indexes are presented in an effective format for presentation to the general public. Examples of the form of presentation

are illustrated in Exhibit IV-1.

A useful survey on environmental indicators was undertaken during an American Association for the Advancement of Science meeting held in Philadelphia, December 26-31, 1971. The proceedings of the symposium have been documented in a book by William Thomas.[1] The proceedings and resulting text illustrate the diversity of current efforts and concepts involved in development of environmental indicators. (The subjects covered range from discussion of specific indicators of air, water quality and noise, to establishing priorities for attention among environmental stresses).

The single most broad-based yearly assessment of where we are and what we hope to achieve in our efforts on environmental quality are the reports of the Council on Environmental Quality (CEQ).[2] The First Annual Report concentrated on suggestions for Federal, State and Local action to better understand problems of the environment and methods to improve it.

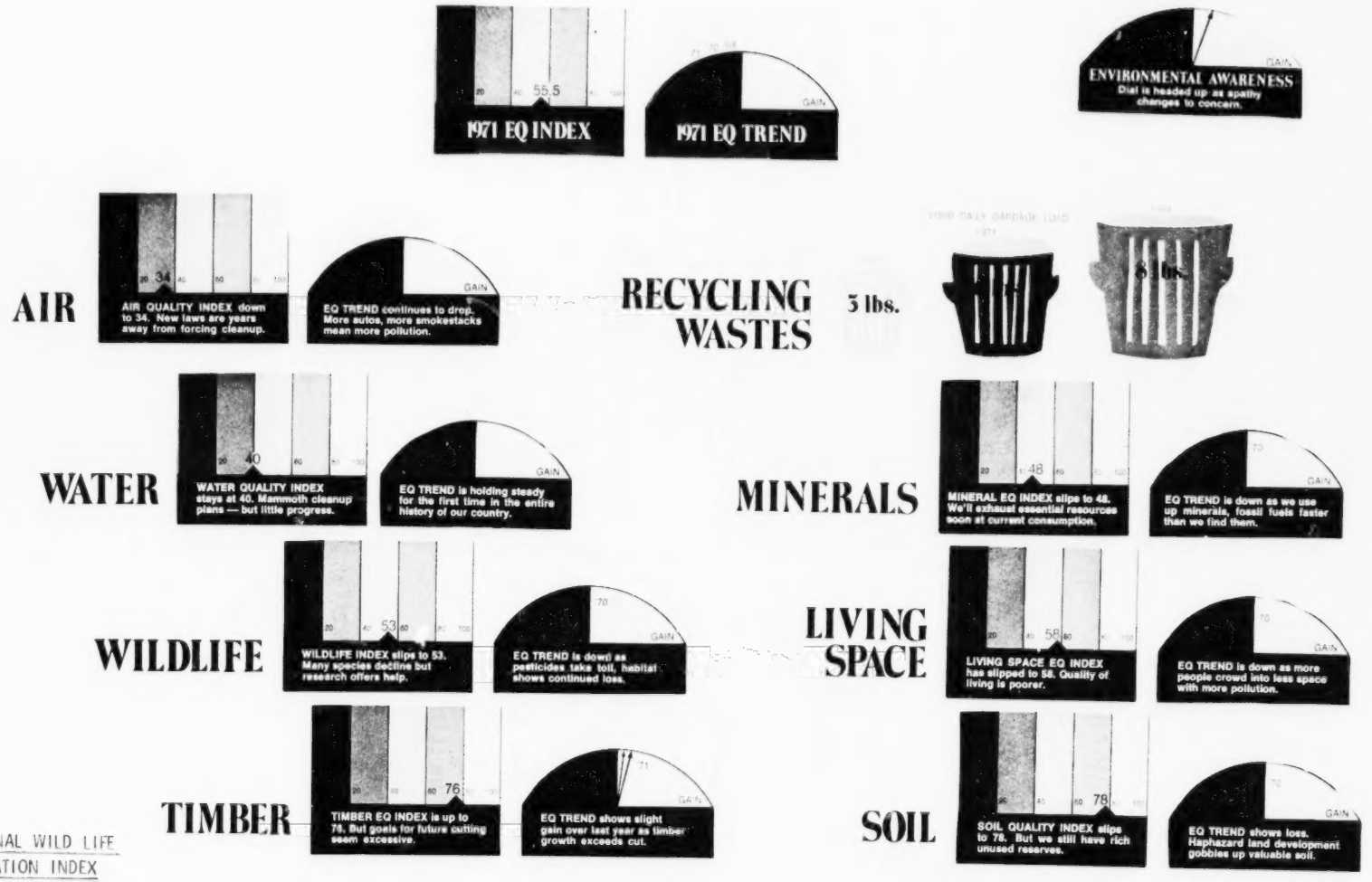
---

1 Thomas, William A. (Ed.). "Indicators of Environmental Quality", Plenum Press, 1972.

2 Council on Environmental Quality. "Annual Reports", U.S. Government Printing Office, Washington, D.C.

EXHIBIT IV-1

EXAMPLES OF NATIONAL WILDLIFE FEDERATION
PRESENTATIONS OF ENVIRONMENTAL QUALITY


55.5
1971 EQ INDEX
GAIN
1971 EQ TREND
ENVIRONMENTAL AWARENESS
Dial is headed up as apathy changes to concern.
AIR
34
AIR QUALITY INDEX down to 34. New laws are years away from forcing cleanup.
GAIN
EQ TREND continues to drop. More autos, more smokestacks mean more pollution.
RECYCLING WASTES
3 lbs.
6 lbs.
WATER
40
WATER QUALITY INDEX stays at 40. Mammoth cleanup plans — but little progress.
GAIN
EQ TREND is holding steady for the first time in the entire history of our country.
MINERALS
48
MINERAL EQ INDEX slips to 48. We'll exhaust essential resources soon at current consumption.
GAIN
EQ TREND is down as we use up minerals, fossil fuels faster than we find them.
WILDLIFE
53
WILDLIFE INDEX slips to 53. Many species decline but research offers help.
GAIN
EQ TREND is down as pesticides take toll, habitat shows continued loss.
LIVING SPACE
58
LIVING SPACE EQ INDEX has slipped to 58. Quality of living is poorer.
GAIN
EQ TREND is down as more people crowd into less space with more pollution.
TIMBER
76
TIMBER EQ INDEX is up to 76. But goals for future cutting seem excessive.
GAIN
EQ TREND shows slight gain over last year as timber growth exceeds cut.
SOIL
78
SOIL QUALITY INDEX slips to 78. But we still have rich unused reserves.
GAIN
EQ TREND shows loss. Haphazard land development gobbles up valuable soil.

NATIONAL WILD LIFE
FEDERATION INDEX

The Second Annual Report concentrated in depth on the economics and legal aspects of environmental quality. The Third Annual Report, issued in August, 1972, updates many of the areas previously covered, but includes a broader base of newer developments notably: development work on environmental indices, international aspects on environmental quality and forecasting the future--examining the impacts of population, resources, technology, etc., on our future environment.

In recognition of the broad-base of interrelated parameters which affect the environment, the Council compiled--in its Third Annual Report--a preliminary list of items of information which should be obtained on a regular basis. These "Environmental Parameters" have been categorized into: Underlying Factors; Resources, Ecological Factors; Pollution and Man-Made Environment as shown in Exhibit IV-2.

The previous examples have illustrated some major work on environmental indicator development and concern. While extensive efforts in developing a range of environmental indices are being undertaken. The following discusses areas of priority development.

C. Priority Areas for Indicator Development

1. Areas of Immediate Concern

a. Air and Water Pollution

Air and water pollution are obvious examples of man's impact on the environment, and effective cleanup

EXHIBIT IV-2

ENVIRONMENTAL PARAMETERS

UNDERLYING FACTORS

Population

Absolute size--United States and world
Birth rate--United States and world
Death rate--United States and world
Age composition
Lifespan, by sex and race
Immigration and emigration

Economic Development

GNP, absolute and per capita, by sector
Capital investment, by sector

Urbanization

Percent population in central cities and suburbs
Percent population, by population size of community

RESOURCES

Supply and Demand--Renewable Resources

Water, by region and type of use
Timber

Supply and Demand-Nonrenewable Resources (United States and world)

Coal
Oil
Metals
Phosphorous
Uranium
Other

Land

Amount of land available for food production
Amount of land used for food production
Amount of urbanized land
Strip-mined land--reclaimed and unreclaimed
Development in flood plains
Land devoted to transportation-related activities--urban and nonurban
Amount of wetlands, by type
Amount of land used for public works projects
Wild and natural areas

Food

Agricultural productivity
World food supply vs. demand (including caloric and protein value)
Fish and other ocean food harvest and reserves

Solid Waste and Recycling

Amount of municipal (residential and commercial) solid waste, by type of waste
Amount of industrial solid waste, by source and type
Amount of agricultural solid waste, by type
Percent materials recycled, by type

Energy

Total BTUs of energy used
Electric power consumed
Mix of fuel used for energy supply
Productivity per energy unit consumed

ECOLOGICAL FACTORS

Climate

Solar radiation amount, by type
Temperature change

Natural Disasters

Earthquakes--property damage and human injury
Hurricanes and tornadoes--property damage and human injury
Floods--property damage and human injury

Wildlife

Wildlife Quality Index
Wildlife Management Effectiveness Index
Wildlife Habitat Index

Maintenance of Major Ecocycles

Nitrogen
Carbon
Other

POLLUTION

Air

Amount of emissions, by type and source (Major pollutants: SO_2, CO, oxidants, NO_2, hydrocarbons, suspended particulates)

Percent population exposed to levels above primary standards (health index)

Ambient air quality (index of ambient levels for each major pollutant and composite index for all pollutants)

Water

Amount of effluents, by source, type of pollutants (Major pollutants: BOD, COD, or TOD, dissolved oxygen, dissolved solids, suspended solids, phosphorus, ph, salinity, oil, phenols, fecal coliform), and type of water body used for disposal
Ambient water quality, by region and type of pollutant
Ocean dumping, amount and type
Number and area of lakes eutrophied
Percent population served by drinking water meeting standards
Subterranean water pollution

Radiation

Major radionuclides present in media
Average human radiation exposure
Number of nuclear accidents

Pesticides

Amounts of pesticides used, by type
Amount of major pesticide types in media, food, and humans
Injuries due to pesticides

Noise

Ambient noise levels, urban and non-urban

Toxic substances

Mercury, in media, food, and humans
Cadmium, in media, food and humans
Other metals in media, food, and humans
Synthetic organic chemicals (other than pesticies) in media, food, and humans

MANMADE ENVIRONMENT

Housing

- Percent substandard housing
- Housing availability
- Density per square mile
- Neighborhood quality

Transportation

- Journey-to-work time

Aesthetics

- Billboards and junkyards per mile
- Proportion of urban green space

Occupational Environment

- Work injuries
- Workplace pollution

Recreation

- Open space--parks, wilderness
- Cultural facilities
- Work/leisure time ratio

and prevention measures are generally noticeable soon after corrective action is taken. Indices of water and air "purity" are receiving prime attention.

b. Hazardous Substances

Hazardous substances such as mercury, cadmium, lead, and persistent pesticies are of increasing concern and danger. Radioactivity levels may become a serious problem as nuclear reactors become a widely used source of electric power or as other uses of radioactivity increase. Acceptable levels have been established based on available and current knowledge. However, for many substances, "normal" or "background" levels are not known. As more and more substances are shown to be damaging to human or other life, indices of hazards must be established.

c. Water Disposal/Recovery

Water disposal relates to water pollution (overflow of untreated sewage), air pollution (incineration), land use (sanitary land fill, open dumps), and recycling. Most air and water pollution is a type of waste disposal, but an index developed for this area is intended to cover sewage treatment facilities (which could be included under water pollution) and solid waste disposal. This index may be considered as a quality index and computed relatively easily once standards are set.

d. Land Use

Land management reflects not only soil conservation practices but also land usage shifts brought about as a result of growths in urban populations. Irreversible land use shifts (such as the development of wetlands) are of concern as "idle land" becomes more scarce and as the ecological value of areas previously thought worthless becomes known. In the future, land use practices will probably be regulated by increasing zoning regulations (which are included under "control measures") if the public good is to be served. By focusing upon land use and soil conservation practices in a land management index, the choices made by an increasingly urban population become more visible, and alternative practices may be more carefully considered.

e. Resource Depletion

The supply of resources is of concern as population size grows and per capita consumption increases. Living resources, if managed properly, may be effectively maintained. Management can have considerable impact on social and economic health. Non-living resources, especially minerals, may become scarce if wasteful practices are encouraged and if alternative energy sources and minerals are not found. Accordingly, it is recognized

that the drain upon our resources should be made evident so that intelligent choices can be made. Indices for this area should categorize resources by use or application--not physical description alone.

2. The Broader Needs

In addition to focusing on the development of environmental indicators of immediate concern, a broader scale approach on environmental indicators is now being undertaken. These efforts range from fundamental developments of indicator concepts to more immediate developments of environmental measures and indicators at the city, state, region, and national level.[1] Basic concept and methodology development for environmental indicators, however, is at an infancy state.

Approaches to more fundamental development of environmental indicator concepts are reflected in such papers as "Environmental Indicators: An Overview". This paper was presented by Perloff at the June 1972 Environmental Design Research Association Conference. The ongoing research

---

[1] Examples of environmental indicator development work at an urban and regional level include: "Environmental Quality Index - A Feasibility Study - County of San Diego Regional Issues, Volume 1", June 1972, by McDonald and Malcolm of Research Analysis Corporation; and "The Quality of Life in Metropolitan Washington, D.C., Some Statistical Benchmarks", Jones and Flax, The Urban Institute, March, 1970.

efforts of the Office of Research and Monitoring at the Environmental Protection Agency and the symposium on the "Quality of Life" Concept, sponsored by EPA in August 1972, are additional examples of attention now being focused on more fundamental environmental indicator development.

CHAPTER V

QUALITY OF LIFE INDICATORS--
AN ALL ENCOMPASSING EFFORT

A. Introduction

Simultaneously with the recent efforts on development of social and environmental indicators, attempts have been made to develop an all-inclusive quality of life indicator. Some of this work is subsumed within the context of development of social indicators over the past decade. However, most of the work directed toward a comprehensive view of an indicator of the Quality of Life--including economic, social and environmental aspects--is quite recent.

In addition to research and studies on the Quality of Life, the press has recently reflected wide public interest in the concept. For example, Norway's recent public referendum which rejected joining the European common market has been reported as a public evaluation that economic well being now has a lower national priority than a more encompassing Quality of Life criteria. The Washington Post of November 1, 1972, noted a similar trend in Japan in an article, "Japanese Goals Readjusted" by Joseph Selvin. Selvin notes that "Japan is abandoning its stunningly successful, breakneck drive for booming economic growth for an equally ambitious campaign to better the living conditions of its 106 million...people". He notes further that "instead of seeking more production Japan intends to improve the quality of life in its mountainous,

congested archpelago."

Some examples of attempts to address a construct of the Quality of Life will illustrate the variety of approaches now being undertaken:

B. Examples of Related Work

A recent symposium conducted by Dr. Fred Singer at the University of Virginia on "Can We Develop an Index for the Quality of Life" addressed approaches to develop an index of the quality of life. This and other such symposia are examples of the broad methodology examination currently being undertaken on the Quality of Life concept.

At the executive level of government, the current effort within the Office of Management and Budget--previously cited under the Social Indicator Chapter--is striving to develop Social Indicators. The results of this work are planned for publication in 1973. It is particularly significant that an effort of this magnitude is being undertaken at a level which can impact on national policy.

The "Report of the White House Conference on Youth" of April 1971, suggested the following criteria for inclusion in reflecting the Quality of Life Concept in decision making at the national level:

(1) Natural Environment. Preservation of natural beauty and wildlife and opportunity to regularly experience

unspoiled wilderness and water. Tabulation on the use of reserves of natural resources.

(2) Living Environment. Overall maintenance of urban, suburban and rural living and working areas. Maintenance of minimal conditions for clean air and water, available space, general sanitation and health, housing and structural safety and building and street aesthetics.

(3) General Health. Basic sanitation and safety maintenance, ample available health care and intensive medical services for the young and elderly.

(4) Income and Basic Economic Security. Minimization of individual economic deprivation, minimum guaranteed living standard, equitable distribution of wealth and continual opportunity to pursue improved economic conditions.

(5) Employment and Productivity. General provision for productive opportunity which provides equitable distribution of wealth and continual opportunity to pursue improved economic conditions.

(6) Productive Employment Areas. Study of the variations from the mean which exist within minority groups regarding educational attainment in relation to earning power.

(7) Aggregate Economic Advancement. Overall economic production of society which takes into consideration negative and preventive production (such as smog control devices) and environmental deterioration costs.

(8) Training, Education and Culture. Opportunity to learn useable skills, problem solving abilities and the value of the world.

(9) Justice and Freedom Concerning Threat and Coercion.

Minimum threat of harm or less of security. Extent of positive as opposed to negative sanctions used in social and individual interaction.

(10) Individualism. Opportunity for free expression and selection of "life style", and levels of social tolerance and alienation.

It should be noted that each of these "criteria" may be categorized under one of the three indicator areas--economic, social and environmental. However, the categorization is by no means mutually exclusive. Furthermore, these "criteria" have not been reduced to specific measures and subsequently to indicators.

The use by Cantril and Roll of the "self-anchoring striving scale"[1] is an excellent example of an approach that recognizes the criticality of establishing a value system through participation of the population.

A brief extract from their report follows:

---

[1] The "self-anchoring striving scale" was introduced by Hadly Cantril and Lloyd Free in studies conducted by the Institute of International and Social Research. See The Hopes and Fears of the American People by Albert H. Cantril and Charles W. Roll, Jr.

"In the striving scale technique, the respondent is first asked to describe what life would be like if he were to imagine his future in the best possible light". This question is open-ended and the respondent's comments are recorded verbatim by the interviewer. The respondent is then asked the opposite: "What his future would be like in the worst possible light". Again, his comments are recorded verbatim. The actual working of the question follows:

> All of us want certain things out of life. When you think about what really matters in your own life, what are your wishes and hopes for the future? In other words, if you imagine your future in the best possible light, what would your life look like then, if you are to be happy? Take your time in answering; such things aren't easy to put into words.
>
> Now taking the other side of the picture, what are your fears and worries about the future? In other words, if you imagine your future in the worst possible light, what would your life look like then? Again, take your time in answering.

The substance of the hopes and fears mentioned is subsequently coded by major categories of concern.

The respondent is next shown a picture of a ladder, symbolic of the ladder of life (see Figure 1). The top rung

of the ladder, he is told, represents the entire complex of hopes he has just described as the ideal state of affairs, and the bottom run represents the worst state of affairs. He is then asked to indicate where he feels he stands on the ladder at the present time in relation to his aspirations, where he believes he stood five years ago, and where he thinks he will be five years hence.

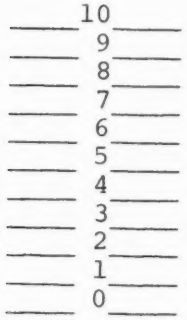


Figure 1

The respondent's ladder ratings are self-anchored in that the top and bottom of the ladder are defined in his own terms. Thus a present ladder rating of "6" for an upper-middle class housewife in the New York suburbs is the psychological equivalent of a "6" rating for a sharecropper in the Southwest even though the substance of their hopes and fears may differ markedly. Further, the respondent's three ladder ratings can be compared, giving a measure of his personal sense of accomplishment (as indicated by the ladder rating shift from past to present) and personal sense of optimism (as indicated by the shift from present to future). The same series of interrelated questions is then asked about the United States to determine the respondent's hopes and fears for the nation.

> The respondent is asked to describe the best and worst possible states of affairs for the United States and to indicate national ladder ratings for past, present, and future.

One result of their study is illustrated in Exhibit V-1. (This exhibit also includes the earlier results of Hadley Cantril and Lloyd Free). The results reveal a first priority in aspiration for good health and better standards of living. The change in percent rankings over time also reveals another feature of QOL priorities--changes over time and circumstances. Additional studies reveal variations in results by age group, educational level, race, etc.

Again, the items defined under "The Personal Hopes and Fears" can be structured under the three categories previously discussed. These studies also are indicative of progress in procedures to seek ranking and establish value systems. The elements, however, pose difficult problems in quantification measures, and subsequently as indicators, for use as a basis of policy decisions.

Applications of measuring the Quality of Life in urban environments are valuable "grass root" sources to increase our understanding and to lead to practical policy guides--at least at the local level. The study undertaken by the Urban Institute "The Quality of Life in Metropolitan Washington, D.C.", and reported in 1971, used twelve indicators in making

EXHIBIT V-1 PERSONAL HOPES AND FEARS
In Percentages*

	Personal Hopes		
	1959	1964	1971
Good health for self	40	29	29
Better standard of living	38	40	27
Peace in the world	9	17	19
Achievement of aspirations for children	29	35	17
Happy family life	18	18	14
Good health for family	16	25	13
Own house or live in better one	24	12	11
Peace of mind; emotional maturity	5	9	8
Having wealth	2	5	7
Having leisure time	11	5	6
Happy old age	10	8	6
Good job; congenial work	7	9	6
Employment	5	8	6
Freedom from inflation	1	2	6
Other general concerns for family	7	4	5

	Personal Fears		
	1959	1964	1971
Ill health for self	40	25	28
Lower standard of living	23	19	18
War	21	29	17
Ill health for family	25	27	16
Unemployment	10	14	13
Inflation	1	3	11
Unhappy children	12	10	8
Drug problem in family	--	--	7
Pollution	--	--	7
Political instability	1	2	5
No fears at all	12	10	5
Crime	--	--	5

Extract from "The Hopes and Fears of the American People", by Albert H. Cantril and Charles W. Roll, Jr.

*A shift of 4 percentage points among the three studies (1959, 1964, 1971) is considered statistically significant.

comparisons among eighteen large urban areas. A similar study of New York is now being undertaken.

The Environmental Protection Agency--in particular the Office of Research and Monitoring--has a series of ongoing efforts to assist in, and benefit from, developments in the Quality of Life Concept. One of the programs of special interest is the work conducted under the EPA Fellows Program conducted during the summer of 1972. Some of the preliminary findings of the Quality of Life Study Team of the EPA Fellows Program are of special interest in relation to the work just discussed. This group structured the Quality of Life into the following "sectors"--Economic Environment, Political Environment, Social Environment, Health, and Natural Environment. Under these sectors, a total of 30 "factors" were developed and "sub-factors" developed under the factors. For example, under the Social Environment sector, one of the factors is Community, sub-factors of Community include civic, religious, etc. The rationale followed is to continue a structuring to a level which is measurable by well-defined means--then to establish an indicator at that level. The approach has considered merit--the original definition of sectors and factors is not biased by the requirement of quantitative measure. A level of detailed substructuring is continued until a measurable definition

EXHIBIT V-1 PERSONAL HOPES AND FEARS
In Percentages*

	Personal Hopes		
	1959	1964	1971
Good health for self	40	29	29
Better standard of living	38	40	27
Peace in the world	9	17	19
Achievement of aspirations for children	29	35	17
Happy family life	18	18	14
Good health for family	16	25	13
Own house or live in better one	24	12	11
Peace of mind; emotional maturity	5	9	8
Having wealth	2	5	7
Having leisure time	11	5	6
Happy old age	10	8	6
Good job; congenial work	7	9	6
Employment	5	8	6
Freedom from inflation	1	2	6
Other general concerns for family	7	4	5

	Personal Fears		
	1959	1964	1971
Ill health for self	40	25	28
Lower standard of living	23	19	18
War	21	29	17
Ill health for family	25	27	16
Unemployment	10	14	13
Inflation	1	3	11
Unhappy children	12	10	8
Drug problem in family	--	--	7
Pollution	--	--	7
Political instability	1	2	5
No fears at all	12	10	5
Crime	--	--	5

Extract from "The Hopes and Fears of the American People", by Albert H. Cantril and Charles W. Roll, Jr.

*A shift of 4 percentage points among the three studies (1959, 1964, 1971) is considered statistically significant.

is achieved. Another valuable aspect of this work is the team's correlation of the factors of Quality of Life developed independently by others in the past few years with those established by the study team. This correlation sets in perspective similarities and differences of a number of efforts in the area.

A recent paper includes a discussion of a concept for developing a Quality of Life Indicator from a set of sub-indicators and a rationale for combining such indicators into a resource allocation scheme for improvement of the Quality of Life.[1] A definition of Quality of Life is suggested which provides a relationship of weighted societal preferences for achievement of individual environmental, socio-political and economic goals. The functional relationship is defined as $QOL = \sum_{i=1}^{n} w_i (I_i)$; where w_i is a preference function derived from society for the elements of QOL expressed by the indicators I. Functional relationships are also defined between Resource Costs (RC_i) required to maintain and improve QOL and the indicators of status I. A numerical example is then exhibited in which an allocation of Resource Costs (RC_i) is made to maximize QOL. Problems in establishing

---

[1] "How Do We Know Where We Are Going" by Dr. Peter W. House, Presented to a Seminar on Multiple Criteria Decision Making at the University of South Carolina on October 26-27, 1972.

an acceptable rationale for QOL and in deriving indicators and preferential weightings are discussed in detail.

The rationale and problems discussed provide a useful vehicle for summarizing some of the key problems faced in developing a quality of life indicator. Accordingly a summary of the concept is included as Appendix A of this report.

C. Assessment of State of Development

Our ability to perceive, structure and develop a useable construct of the Quality of Life is, at present, rudimentary. We are not at a stage of development where an overall index applicable to policy making is feasible. Perhaps the range of approaches from in-depth metropolitan studies to broad overviews of the problem will, if carefully synthesized, lead to a better understanding of what we can reasonably hope to achieve. In any event, public concern with the issue of quality of life should hasten more systematic efforts to produce useful measures and indicators.

APPENDIX A

APPENDIX A

MEASURING THE QUALITY OF LIFE AND ALLOCATING THE RESOURCES FOR ITS IMPROVEMENT

Introduction

This Appendix discusses a concept for developing a Quality of Life indicator from a set of sub-indicators and a rationale for combining such indicators into a resource allocation scheme for improvement of the Quality of Life. The translation of the concept and rationale described into an operational system would involve extremely difficult theoretical and practical problems. However, the suggested approaches may be helpful in formalizing the attack on these problems.

Measuring the Quality of Life

Measures of success and their indicators are a key to knowing where we are and where we would like to be. The ultimate measure would be a Quality of Life indicator.

A measure of the QOL can be carried out in a number of ways. QOL can be defined by a set of indicators which attempt to encompass a number of relevant factors comprising QOL, or it can be represented by a single index. We will illustrate the development of a set of indicators from a series of descriptors which (for argument's sake) are defined as being an all-inclusive list of the factors which make up the Quality of Life. Such a list would be similar to that in Exhibit A-1. The list divides into three major areas: environment, socio-political, and economic.

EXHIBIT A-1

QUALITY OF LIFE FACTORS

ENVIRONMENT

Air
Water
Noise
Radiation
Solid Waste
Hazardous Substances (Pesticide/Chemical)
Aesthetics
Land Use
Natural Resources
Housing
Transportation
Utilities
Material Quality
Communication and Media

SOCIO-POLITICAL

Education
Privacy
Safety
Personal Skills
Equality
Community
Health
Choices in Life
Social Relationships
National Security
Democratic Process
Justice

ECONOMIC

Accumulated Assets
Living Costs
Income Distribution
Economic Security
Economic Growth
Public Spending
Discretionary Income
Leisure

Assume the indicators developed from these factors are expressed in the following form:

$$Ii = \int (\text{Status of Factor/Desired Level of Factor})$$

This relationship implies that for every factor under consideration we will obtain both a measure of its status and a measure which reflects the desired level for the same phenomena. The initial scale of values could be established by inquiry or well established standards, with a value of 10 assigned to the desired (or optimum) level and numerical values assigned in decreasing order to lower levels of satisfaction.[1/] Ongoing measures of status would either be directly obtained from monitoring data or obtained from a suitable surrogate whose movement correlates highly with the factor under consideration. The ratio of the status score to the desired level score will then yield a measure of the current performance of the system defined by the indicator I.

We will now describe a rationale for combining the individual indicators into an index of the Quality of Life, where: $QOL = \int [I_i \ldots In]$.

The individual indicators for the factors in this expression constitute a profile of the QOL - but not a single number. To convert this profile to a single measure let us hypothesize an additional combinatorial process. We shall assume that this additional process is possible through use of a Preference Function.

1/ See for example the development of the "self-anchoring striving scale" introduced by Hadley Cantril and Lloyd Free in studies conducted at the Institute of Institutional and Social Research

The preference function can be viewed as a measure of the relative importance; i.e., a weighting (w) of factors and their resultant indicators by the members of society. The concept consists of a relative ranking of the factors which make up the Quality of Life by a randomly chosen sample of the population. The derivation of this weighting (w) is assumed to be feasible. The specific method used in operationalizing this weighting scheme is not necessary for this discussion[2/]. Having derived this weighting of factors we can define the Quality of Life Indicator as follows:

$$QOL = \sum_{i=1}^{n} w_i \quad (Ii)$$

We now have a defining relationship between individual indicators and QOL based on a Preference Function or weighting of indicators. How do we allocate our resources to improve this QOL in an optimum manner? Assume that we have definable resources (RC) to allocate for maintenance and improvement of QOL. The resources under consideration consist not only of money but of time, power and other resources at the disposal of the system.[3/] In short, it is a function which measures the relative cost to either maintain the system at levels which it considers adequate or expenditures which it

---

[2/] The "self-anchoring striving scale" approach of Cantril and Free--previously cited--is one method of operationalizing this weighting scheme.

[3/] The translation of such diverse resources into a common measure is one of the formidable theoretical problems requiring solution.

makes to redress imbalances which it wants to correct. The cost is measured so that it can be defined in terms of raising the level of each indicator by one unit. That is, we have a defining relationship between Ii and RCi.

The Resource Allocation Scheme

For purposes of illustrating resource allocation to maximize QOL, we will select a numerical example utilizing the QOL relationship just defined and make the following additional assumptions.

a. Assume that the QOL relationship includes three indicators,

I_1 - Environmental Indicator

I_2 - Social/Political Indicator

I_3 - Economic Indicator

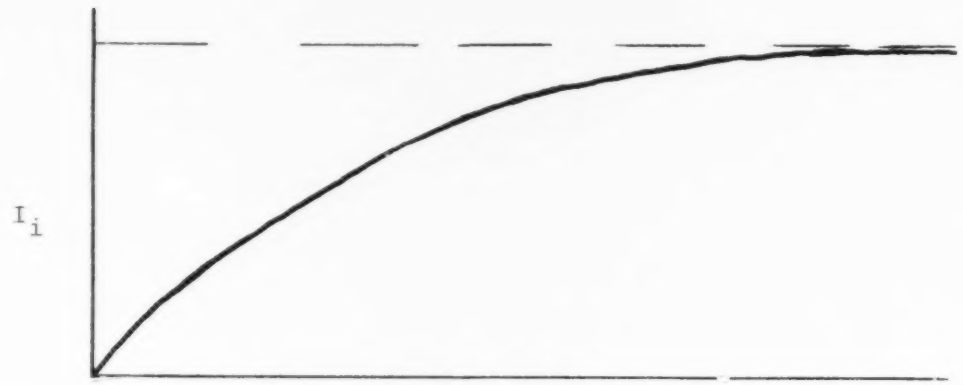
b. Assume that a Preference Function; i.e., importance measured by weighting for a culture, has been established for each of the areas defined by these indicators:

w_1 - Environmental Preference Weighting

w_2 - Social Preference Weighting

w_3 - Economic Preference Weighting

c. Assume further that we have defined functional relationship between the Resource Costs (RC) required to maintain and improve the indicators, I, which constitute the QOL. This relationship is assumed to show diminishing returns to expenditures past a certain point. That is, we have relationships of the general form shown in Exhibit A-2.



RESOURCE COST (RC_i)

Note that this relationship will be typically nonlinear (i.e., for a fixed amount of resources allocated $I_i = \int$(level I_i)) and approaches the desired level of I asymptimatically. Note also that we can approximate an incremental change I_i / RC_i by a linear ratio or slope.

d. Assume that we have available to us 1000 Resource Cost units -- 900 of which are required to maintain the current level of QOL and 100 of which are available for improving QOL.

With the foregoing assumptions we will now proceed to illustrate a resource allocation scheme to improve QOL with a numerical example.

Numerical Resource Allocation Example

a. Given indicators of the following values:

$I_1 = .9$; $I_2 = .4$ and $I_3 = .7$

b. Given preference function weightings:

$w_1 = 50$; $w_2 = 20$ and $w_3 = 30$

c. Given Resource Costs (RC_i) the resource costs to raise the I's one percent are obtained from slopes derived from such relationships between I_i and RC_i as depicted in

Exhibit A-2. Assume the following have been so derived:

$$RC_1 = 25$$

$$RC_2 = 10$$

$$RC_3 = 20$$

The above set of values is summarized below:

$I_1 = .9$	$w_1 = 50$	$RC_1 = 25$
$I_2 = .4$	$w_2 = 30$	$RC_2 = 10$
$I_3 = .7$	$w_3 = 20$	$RC_3 = 20$

Thus:

$$QOL = \sum w_i I_i = 50\ (.9) + 30\ (.4) + 20\ (.7) = 71$$

We now wish to allocate 100 units of RC to maximize improvement of QOL

Allocation of 100 units to I_1 yields QOL of 2.0

Allocation of 100 units to I_2 yields QOL of k 3.0

Allocation of 100 units of I_3 yields QOL of 1.0

Our maximum benefit in this case would be allocation of all our resources to the social/political sector. Following such allocation we have:

$$QOL = 50(.9) + 30(.5) + 20(.7) = 74$$

Obviously, the problem just illustrated could be made a great deal more realistic and complex by taking into consideration the changes in the three functions each year; but even here the solution is amenable to standard linear programming techniques. The above examples suffice to indicate the concept.

Problems to Overcome

The previous description of a QOL construct allows us not only to define our current system but, if measurement could be implemented, it could give us a powerful tool for forecasting and influencing future events. For example, the theoretical structure behind the Preference Function suggests that the society's intrinsic nature is quite stable and the society will go to some lengths to maintain it. This measure, of course, is subject to change over time, but is conceived of as relatively permanent--usually taking long periods to readjust the societal equilibrium.

On the other hand, it is possible to influence this Function in the short run. A concerted effort on the part of the public or private sector to emphasize one or more segments or factors can temporarily change the Preference Function. To the extent that this change becomes imbedded in the society, the Preference Function is changed for the long term. If it is not, the influence is of the nature of a fad, and the Function returns to its former value. The current interest in the environment is a case in point. It is obvious that the environment and its problems did not suddenly come into being. The interest evidenced recently has come about because of a concerted effort on the part of many groups to make us more aware of the dangers and needs of our physical system. To the extent that those who are most concerned succeed in implanting an "environmental ethic",

then the Preference Function will be readjusted to reflect this change in the ethos of the society. If they fail, then the present trend could very well be no more than a fad.

One of the controversial portions of the proposed QOL construct is the ability to get meaningful measures of both the subjective and objective parameters making up the Quality of Life. Much effort has gone into the theory of construction of indicators, yet the field is still in the infancy stage. Work needs to be done to determine what data is needed on the measurement of the factors selected, and to determine whether the factors and indicators chosen are usefully sensitive to the ideas that are to be measured.

APPENDIX B

BIBLIOGRAPHY OF RELATED WORK ON INDICATORS

Author Listing

Barth, D. S., W. F. Durham, C. P. Porter and J. C. Cross. Environmental Standards, Environmental Protection Agency, Research Triangle Park, North Carolina.

Bauer, Raymond A. (Ed.). Social Indicators, MIT Press, Cambridge, Mass., Fourth Printing, 1972.

Bauer, Raymond A. "Societal Feedback", The Annals of the American Academy of Political and Social Science, Vol. 2, 1967, pp. 180-192.

Berle, A. A. "What GNP Doesn't Tell Us", The Saturday Review, August 31, 1969.

Boyce, David E. "Toward a Framework for Defining and Applying Urban Indicators in Plan-Making", Urban Affairs Quarterly, December, 1970.

Cetron, Marvin J. and Donald N. Dick. Measurement and Technology Assessment, Forecasting International, Ltd., Fairfax, Virginia.

Cetron, Marvin J., et al. Technical Resource Management: Quantitative Methods, Cambridge, Mass., 1970.

Christakis, Alexander N. "The Club of Rome Project Methodology", Working Paper, September 10, 1970.

Christakis, Alexander N. and Nake M. Kamrany. "Social Indicators In Perspective", Paper for the System Development Corporation, Santa Monica, California, July 23, 1969.

Clark, Henry. "The Changing Character of American Values", The Futurist, February 1970, pp. 9-11.

Corning, Peter A. "An Index for the Quality of Life", Paper Presented at the 138th Meeting of the American Association for the Advancement of Science, December, 1971.

Dalkey, Norman C. Quality of Life, Rand Corporation, Santa Monica, California, 1968.

Dennison, Edward F. "Welfare Measurement and the GNP", Survey of Current Business, 1970.

Duncan, Otis Dudley. Toward Social Reporting: Next Steps, Russell Sage Foundation, New York, 1969.

Etzioni, Amitai and Edward W. Hehman. "Some Dangers in 'Valid' Social Measurement", The Annals of the American Academy of Political and Social Science, Vol. 2, 1967.

Gastil, Raymond D. "Social Indicators and Quality of Life", Public Administration Review, Nov./Dec., 1970.

Gross, Bertram M. and Michael Springer. "New Goals for Societal Information", The Annals of the American Academy of Political and Social Science, Vol. 2, 1967.

Gross, Bertram M. and Michael Springer. "Social Goals and Indicators for American Society", The Annals of the American Academy of Political and Social Science, Vol. 1, 1967.

Gross, Bertram M. and Michael Springer. "Social Goals and Indicators for American Society", The Annals of the American Academy of Political and Social Science, Vol. 2, 1967.

Henriot, Peter J. "Political Implications of Social Indicators", Speech before the 1971 Annual Meeting of the American Political Science Association, Chicago, Illinois, September 7-11, 1971.

Henriot, Peter J. "Political Questions About Social Indicators", Western Political Quarterly, Vol. XXIII, June, 1970.

House, Peter W. "Performance Criteria for the Environment", Environmental Progress in Science & Education, New York, May, 1972.

Huddle, Franklin P. The Evolution and Dynamics of National Goals in the United States, Congressional Research Service, Washington, D.C., 1971.

Jones, Martin V. and Michael J. Flax. The Quality of Life in Metropolitan Washington, D.C.--Some Statistical Benchmarks, The Urban Institute, Washington, D.C., March, 1970.

Johnston, Denis F. "Social Indicators and Social Forecasting", May, 1970.

Joyce, Robert E. "Systematic Measurement of the Quality of Urban Life, Prerequisite to Management", Seminar on Management of the City, Research Analysis Corporation, May, 1971.

Linowes, David F. "Accounting for Social Progress:Yardsticks Must be Found for Public Programs", The New York Times, March 14, 1971.

Marcuse, Peter. "Social Indicators and Housing Policy", Urban Affairs Quarterly, December, 1971.

Markley, O. W. Alternative Futures:Contexts in Which Social Indicators Must Work, Stanford Research Institute, Menlo Park, California, February, 1971.

Mitchell, Arnold, Thomas J. Logothetti and Robert E. Kantor. An Approach to Measuring Quality of Life, Stanford Research Institute, Menlo Park, California, September, 1971.

Morse, Elliott R. "Report on the Social Indicators Conference", Conference held at George Washington University, Sponsored by the National Science Foundation, November 5-6, 1971.

Moynihan, Daniel P. "Urban Conditions:General", The Annals of the American Academy of Political and Social Science, Vol. 1, 1967.

Overly, Don. Introducing Societal Indicators Into Technology Assessment, International Research and Technology Corporation, Washington, D.C.

Perloff, Harvey S. "Environmental Indicators:An Overview", ERDA Conference, January, 1972.

Perloff, Harvey S. (Ed.). "A Framework for Dealing with the Urban Environment:Introductory Statement", The Quality of the Urban Environment, Washington, D.C., 1969.

Perloff, Harvey S. and Lowdon Wingo, Jr. "Planning and Development in Metropolitan Affairs", Journal of the American Institute of Planners, Vol. 28, No. 2, May, 1962.

Plessas, Demetrius J. and Ricca Fein. "An Evaluation of Social Indicators", Journal of the American Institute of Planners, January, 1972.

Rokeach, Milton and Seymour Parker. "Values as Social Indicators of Poverty and Race Relations in America", The Annals of the American Academy of Political and Social Science, March, 1970.

Sanoff, Henry and Sidney Cohn (Editors). "Proceedings of the 1st Annual Environmental Design Research Association Conference,"North Carolina State University, 1972.

Sawhill, I. V. "The Role of Social Indicators and Social Reporting in Public Expenditure Decisions", Paper submitted to the Joint Economic Committee of the U.S. Congress, Washington, D.C., Government Printing Office, Vol. 1, 1969.

Schmalz, Anton B., et al. Social Indicators, New World Systems, Inc., July, 1972.

Sheldon, Eleanor B. and Howard E. Freeman. Notes on Social Indicators:Promises and Potential, Russell Sage Foundation, New York, 1970.

Sheldon, Eleanor B. and Wilbert E. Moore (Editors). Indicators of Social Change, Russell Sage Foundation, New York, 1968.

Sills, David L. (Ed.). International Encyclopedia of the Social Sciences, Macmillan Company and Free Press, New York, 1968.

Strickland, John and Thomas Blue. Environmental Indicators for Pesticides, Stanford Research Institute, Menlo Park, California, April, 1972.

Terleckyj, Nestor E. "Measuring Possibilities of Social Change", Looking Ahead, August, 1970.

Thomas, W. A., L. R. Babcock, Jr., and W. D. Shults. Oak Ridge Air Quality Index, Oak Ridge National Laboratory, Oak Ridge, Tenn., September, 1971.

Toffler, Alvin. "The Art of Measuring the Arts", The Annals of the American Academy of Political and Social Science, Vol. 2, May, 1967.

Wurster, Catherine Bauer. Framework for an Urban Society, The Report of the President's Commission on National Goals, Prentice-Hall, Inc., 1960.

Additional References

Stanford Research Institute. Toward Master Social Indicators, Bureau of Research, U.S. Office of Education, Washington, D.C., February, 1969.

Environmental Studies Board. Monitoring the Environment, NAE/NAS, January, 1970.

Proceedings of the Conference on Socio-Environmental Indicators. Department of Planning and Economic Development, Honolulu, Hawaii, March 15-17, 1971.

The Mitre Corporation. Development of Environmental Indices: Outdoor Recreational Resources and Land Use Shift, Presented to the American Association for the Advancement of Science, December 26, 1971.

Congressional Record. "Need for a Council of Social Advisors", Proceedings and Debates of the 92nd Congress, First Session, Vol. 117, No. 126, August 5, 1971.

Congressional Record. "Introduction of the Full Opportunity and National Goals and Priorities Act", Proceedings and Debates of the 92nd Congress, First Session, Vol. 117, No. 3, January 25, 1971.

Smithsonian Institution. "Development of a Continuing Program to Provide Indicators and Indices of Wildlife and the Natural Environment", Final Report to the Council on Environmental Quality, April 15, 1972.

U.S. Environmental Protection Agency. Proceedings of the Interagency Conference on the Environment, Livermore, California, October 17-19, 1972.

Earth Satellite Corporation. Land Use Indicators of Environmental Quality, Washington, D.C.

U.S. Department of Health, Education and Welfare. Toward A Social Report, U.S. Government Printing Office, Washington, D.C., January, 1969.

Research Analysis Corporation. Environmental Quality Index--A Feasibility Study, County of San Diego, Environmental Development Agency, San Diego, California, June, 1972.

The Brookings Institution. Agenda for the Nation, 1968.

Commission on Population Growth and the American Future. Population and the American Future, 1972.

Press Release. Economic Indicators by Federal Agencies, Executive Office of the President, Washington, D.C., June, 1972.

☆ U. S. GOVERNMENT PRINTING OFFICE : 1973—514-154/280